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GENERAL DESCRIPTION OF THE PROTON BEAM DUMP

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The proton beam dump is being designed* to provide a place to deposit the beam power of the NAL synchrotron during periods when the accelerator is being tuned up, during machine testing and when target stations are not in operation. Under normal circumstances, the 400 kilowatt average beam power of the NAL synchrotron would be taken to target stations, of which two are presently under design, Areas 1 and 2. Each of these areas contain high power beam stops designed for continuous operation. The beam dump is normally not expected to be used; therefore, in considering its long term residual activity build-up, we used a 10% duty cycle, averaged over a period of months. This is a conservative maximum operating level. In a sense, the beam power from the machine is being wasted when it is directed into the dump and, therefore, this would be permitted only during periods (see NAL Radiation Policy) during which efforts were being made to improve machine operation.

The beam dump is being designed for two separate phases of operation. In Phase 1, we can operate with no external cooling of the beam dump. During the initial phases of accelerator operation the beam intensity is expected to be lower than the design value and, therefore, there will not be any need for external cooling. The dump has a large heat

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capacity and could (from an ambient of 55°F, which is approximately the earth temperature) rise up perhaps 50°C, after which time the beam would be shut off and the dump would be allowed to cool by natural conduction to the earth. This mode of operation would probably be adequate for something like a 1% duty cycle of the dump which may, in fact, be as much as is ever used.

In the second phase of operation, or full power phase, secondary water will pass through the cooling tubes which have been provided inside the beam dump in order to remove heat. This would preclude any possibility of the dumps temperature rising in excess of 50°C and, conservatively speaking, there is sufficient cooling for dissipating a half a megawatt of heat with only a few (3 to 4°C) degrees temperature rise. This cooling capacity would allow us to run full power into the dump continuously without overheating.

Anticipated activity level. Experimental measurements (see report entitled "Proposal For Increasing Intensity of AGS", BNL No. 7956, May 1964) made at the Brookhaven AGS, to study the deposition of radioactivity into the cooling water of the main magnet coils, were utilized for this study. The activity levels one might encounter in a beam dump of our design can reasonably be determined by extrapolation of the AGS measurements and knowing the relative beam intensity ratios. As is the case in the BNL water system, the only significant long term activity is tritium. The other relatively long term isotopes, such as Be^7, were not developed in sufficient concentrations to present a health hazard. Utilizing the Brookhaven AGS numbers, we find that in our beam dump, assuming a 10% average usage and a once-a-year water change, we expect to accumulate approximately one-tenth of a curie of tritium. The tank contains approximately 20,000 liters of water and results, therefore, in a concentration of approximately 5 x 10^{-6} curies per liter. This is five times the maximum permissible concentration for continuous non-occupational off-site exposure, but well within the limits of potability for on-site consumption.